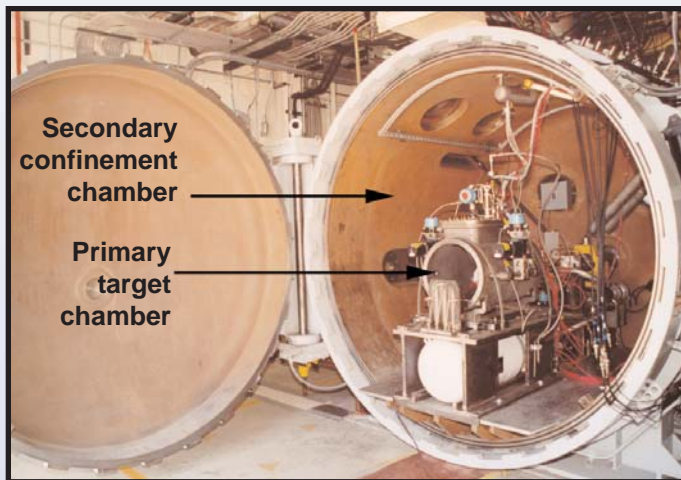




Joint Actinide Shock Physics Experimental Research (JASPER)



The JASPER two-stage gas gun.



The JASPER gas gun chamber.

Introduction

In 1992, the President of the United States placed a moratorium on underground nuclear weapons testing. As a result, alternate experimental methods for certifying the nation's nuclear weapons stockpile were implemented. Among these experimental methods was the Joint Actinide Shock Physics Experimental Research (JASPER) Facility, located at the Nevada Test Site. JASPER plays an integral role in the certification of the nation's nuclear weapons stockpile by providing a method to generate and measure data pertaining to the properties of materials (radioactive chemical elements) at high shock pressures, temperatures and strain rates. These extreme laboratory conditions approximate those experienced in nuclear weapons. Data from the experiments is used to determine material equations-of-state and to validate computer models of material response for weapons applications. Experiment results are used for code refinement, permitting better predictive capability and ensuring confidence in the U.S. nuclear stockpile.

Background

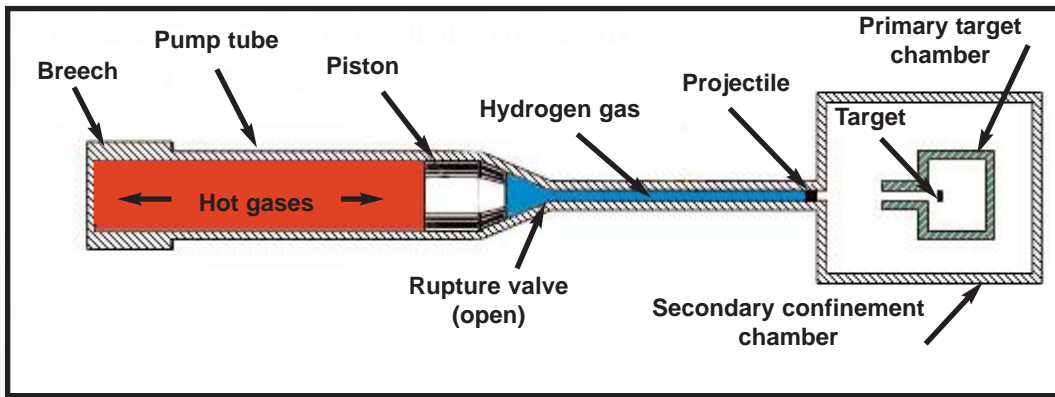
The Joint Actinide Shock Physics Experimental Research (JASPER) Facility is a multi-organizational research facility hosting Lawrence Livermore National Laboratory

(LLNL), Los Alamos National Laboratory, Sandia National Laboratories, the U.S. Department of Energy's National Nuclear Security Administration and National Security Technologies LLC. Lawrence Livermore National Laboratory maintains the responsibility for overall project management, physics definition, engineering, health and safety.

How It Works

JASPER experiments support the Stockpile Stewardship Program in several ways complementing subcritical experiments conducted at the Nevada Test Site. To achieve the high shock pressures, temperatures, and strain rates similar to that of a nuclear weapon, JASPER experiments utilize a two-stage gas gun.





A diagram of the JASPER two-stage gas gun.

The basic concept of a gas gun is to propel a projectile into a target at extremely high velocities, often exceeding eight kilometers per second. The JASPER gas gun is specifically designed to conduct research on plutonium and other surrogate materials as targets.

The two-stage gas gun consists of a first-stage breech containing gunpowder and a pump tube filled with hydrogen gas; and a second-stage evacuated barrel for guiding the high-velocity projectile to a target containing radioactive material. Hot gases from the burning propellant drive a heavy piston down the pump tube, compressing the gas. At sufficiently high pressures, the gas eventually breaks a rupture valve and enters the narrow barrel, propelling a projectile, housed in the barrel, toward the target.

When the projectile hits the target, it produces a high-pressure shock wave. In a fraction of a microsecond, the shock wave reverberates through the target. Diagnostic equipment, triggered by the initial wave, measures the properties of the shocked material inside the target during this extremely brief period. The target is disintegrated by the impact of the projectile and contained within the primary confinement chamber. A second confinement chamber protects workers as a safety precaution in the unlikely event that the primary system fails. The data from these experiments is used by the national laboratories to further refine the computer codes used to certify the U.S. nuclear stockpile

Conclusion

Because of the well-controlled environment of the gas gun, JASPER provides scientists with more precise equation-of-state data than can be obtained from conventional, high-explosive experiments. Nested confinement systems assure that radioactive materials are not released into the gas gun building or the environment after target impact. The primary target chamber houses the target material, and an ultra-fast closure valve system traps radioactive contaminants within the chamber after the projectile enters. A secondary confinement chamber assures that if any material escapes from the primary target chamber, it will not migrate into the building environment.

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Stockpile Stewardship

